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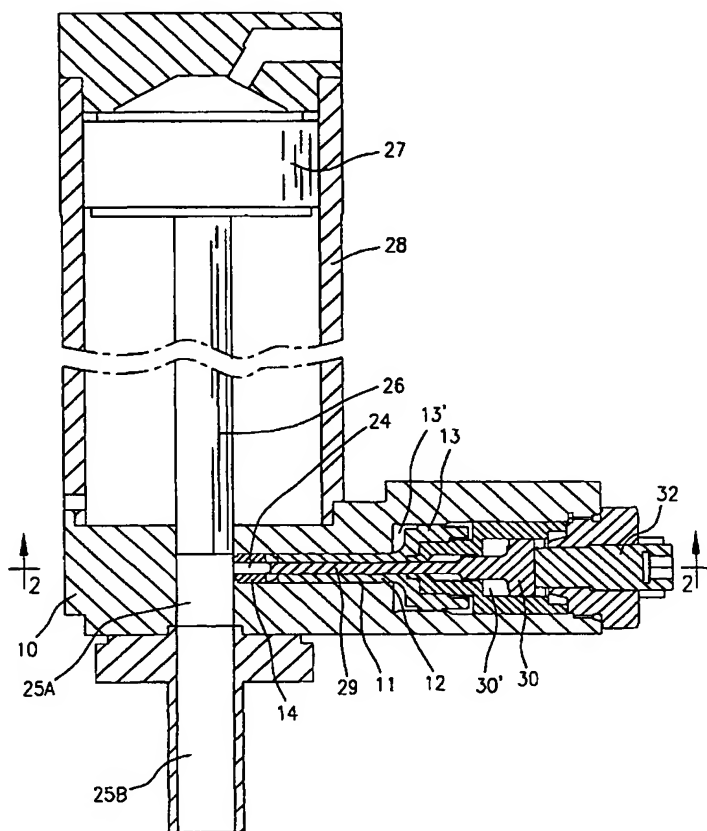
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[Continued on next page]

(54) Title: CO-INJECTION MIXING METHOD AND APPARATUS



(57) Abstract: Method and device (10) for mixing polyurethane - forming reactive chemical components; at least first and second chemical components (A, B) are introduced into a common pressure and feeding chamber, from where the chemical components are made to flow and co-injected through one or more narrow orifices (31) into a mixing chamber. During co-injection of the chemical components (A, B) a first mixing takes place into the jet strim, while a final intimate mixing is performed by impingement and collision into the mixing chamber (24) of the device; selectively actuatable cleaning members (12, 29) eject the residual chemical material remaining into the common pressure and feeding chamber (15), and the mixing chamber (24) of the mixing device (10).



ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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**Declarations under Rule 4.17:**

- *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii)) for the following designations* AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW, *ARIPO patent* (BW, GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), *Eurasian patent* (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), *European patent* (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT,

- *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii)) for the following designation* US
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*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

**AMENDED CLAIMS**

[received by the International Bureau on 29 April 2004 (29.04.04);  
claims 1-13 replaced by amended claims 1-12]

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**STATEMENT**

1. A method for mixing chemically reactive liquid chemical components (A, B) in the production of polyurethane foams and moulded parts, according to which a first (A) and at least a second (B) chemically reactive components are fed under pressure conditions and mixed into a mixing chamber (24), and in which the resulting mixture is made to flow towards an outlet duct (25B), characterized by comprising the steps of:

- providing an annularly shaped common pressure and feeding chamber (15);

- feeding metered quantities of the chemical components (A, B) into the common pressure and feeding chamber (15) subjecting the chemical components (A, B) at a same pressure condition flowing in an unmixed state toward at least one restriction or orifice (31); and

- co-injecting the chemical components (A, B) feed in common, into the mixing chamber (24), through said least one injection orifice (31) causing their intimate mixing by impingement and turbulency.

2. A method according to claim 1, comprising the additional step of pre-mixing the chemical components by the turbulency of the jet during the co-injection.

3. A method according to claim 1, wherein the jumbled chemical components (A, B) are co-injected into the mixing chamber (24), while maintaining in the common pressure and feeding chamber (15) a pressure equal to or higher than 30 bars (3,0 MPa).

4. A method according to claim 3, wherein the pressure in the common pressure and feeding chamber (15) is ranging from 40 to 160 bars (4 to 16 Mpa).

5. A method according to claim 1, in which the mixing chamber (24) is provided with a rear open end, and a flow throttling member (29) having a shaped end axially protruding into the rear opening of the mixing chamber (24) to provide said at least one injection orifice (31), wherein the pressure of the common fed chemical components (A, B) in the common pressure and feeding chamber (15) is changed by adjusting the axial position of the throttling member (15) shaped end in respect to the rear opening of the mixing chamber (24).

6. A method according to claim 1, comprising the step of post-mixing of the resulting mixture outcoming from the mixing chamber (24).

7. A mixing device for mixing reactive chemical components (A, B), having:

- a mixing chamber (24) and an outlet duct (25B); characterized by comprising:
- an annularly shaped common pressure and feeding chamber (15) in fluid communication with said mixing chamber (24);
- said common pressure and feeding chamber (15) having inlet apertures (16, 17) for  
5 separate feeding of the chemical components (A, B), and being conformed for maintaining the flowing of the chemical components (A, B), in common , at a same pressure and in unmixed state; and
- at least one injection orifice (31), conformed and arranged for co-injection of the chemical components (A, B), from the common pressure and feeding chamber (15) into  
10 the mixing chamber (24) of the mixing device (10).

8. A mixing device (10) according to claim 7, comprising a throttling member (29) for the injection orifice (31) coaxially arranged inside the feeding chamber (15), said throttling member (29) having a fore end partially protruding into an inlet aperture of the mixing chamber (24), and conformed to provide said at least one injection  
15 restriction or orifice (31) between opposite edges of inlet aperture of the mixing chamber (24) and the fore end of throttling member (29).

9. A mixing device according to claim 8, wherein the opposite confronting faces at the bottom of the feeding chamber (15) and of the fore end of the throttling member (29) are provided with shaped surfaces defining said at least one injection restriction or  
20 orifice (31).

10. A mixing device according to claim 8, wherein the throttling member (29) is axially adjustable in respect to the inlet aperture of the mixing chamber (24).

11. A mixing device according to claim 7 comprising a cleaning member (29) axially movable within the mixing chamber (24).

25 12. A mixing apparatus according to claims 9 and 11, wherein the cleaning member (29) is consisting of the same throttling member (29).

13. A mixing device according to claim 12, wherein the cleaning and throttling member (29) is movable between an advanced and a retracted position in respect to the mixing chamber (24), and means for adjusting the axial position of the throttling member (29)  
30 and to change the sectional area of the injection orifice (31) at the retracted position of the throttling member (29).

**STATEMENT UNDER ARTICLE 19.1**

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Re: International Application n° PCT/EP 03/12222 filed on 03.11.2003

Applicant: AFROS S.P.A.

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Claims 1 and 7 have been amended by adding the feature relating to the “annular shape” of the common pressure and feeding chamber 15, for better distinguishing the invention in respect to prior art cited in the International Search Report. In particular:

**CLAIM 1:** the step of “providing an annularly shaped common pressure and feeding chamber (15)” has been added at the beginning of the characterized clause; reference number (31) has been also added at line 11 after “orifice” in the amended claim.

**CLAIM 7:** the features relating to the “mixing chamber (24) and the “outlet duct (22)” at lines 2 and 3 of page 22 of original claim, have been removed and passed in the pre-characterizing clause, at line 1 page 22 of the amended claim.

The statement: “characterized by comprising” has been added at page 22 line 1.

The statement: “a common pressure and feeding chamber (15)” has been changed into: “an annularly shaped common pressure a feeding chamber in fluid communication with the mixing chamber (24)” at page 22 lines 2 and 3 of the amended claim.

The amendments are supported by claims 1 and 7 as originally filed and by description page 14 line 30; the amendments do not involve any impact on description and drawings.

ING. LUIGI COLOBERTI